ON THE LENGTH-WEIGHT RELATIONSHIP AND RELATIVE CONDITION IN *TRICHIURUS LEPTURUS* LINNAEUS

K.A. NARASIMHAM

Central Marine Fisheries Research Institute; Unit, Kakinada-2

ABSTRACT

The length-weight relationship and the relative condition in the ribbon fish *Trichiurus lepturus* were studied in 185 males in the size range 355-960 mm and 143 females in the size range 352-1090 mm collected during the period August 1966 to May 1969. Analysis of covariance of the two regressions showed no significant difference in the slopes. Apparently the sexual cycle does not seem to affect the relative condition of the fish, at least directly, while high intensity of feeding influences the K_n. There is a sudden fall in the value of relative condition at 625 mm fish length, and maturity studies indicate that over 90% of fish attained sexual maturity at this length.

INTRODUCTION

The length-weight relationship in the ribbon fish *Trichiurus lepturus* Linnaeus has been studied by Misu (1964) from the East China Sea and Yellow Sea and by Dawson (1967) from the northern Gulf of Mexico. From the Indian waters Prabhu (1955) calculated the length-weight relationship based on 174 specimens, ranging in size 12 - 56 cm. The commercial catches of Kakinada show a wide variation in the size of *T. lepturus* and usually range 35 - 110 cm. The length-weight relationship and the relative condition for this size range are dealt with in this paper.

MATERIAL AND METHODS

A total of 328 fish, comprising 185 males in the size range 355-960 mm and 143 females in the size range 352-1090 mm collected during the period August 1966 to May 1969 from the trawl net catches from the Kakinada area were studied. Fish were measured and weighed in the fresh condition within 3 - 6 hours after capture. Total length was measured to the nearest millimeter from the tip of the snout to the tip of the tail. Weight was recorded to the nearest gram in a double-pan physical balance sensitive to 0.5 gm, with gonads and viscera intact. The length-weight relationship was calculated by the least square method for males and females separately by using the general formula, $W = a L^b$, or its logarithmic form $\log W = \log a + b \log L$, where W is the weight of the fish, and L the length and 'a' and 'b' are constants.

The relative condition factor was calculated as suggested by Le Cren (1951) from the formula $K_n = w/a\ L^b$ (or $W/\hat{W}$, where $\hat{W}$ is the estimated weight). From the individual values, the mean K_n was calculated separately in males and females for each 5 cm length group and also for all the length groups during different months. The annual month-wise and size-wise variations in the mean relative condition showed the same general trend for different years. Hence the data were pooled for the period of study and the mean K_n was calculated. The state of maturity (I.C.E.S. scale) and the volume of the gut contents were also noted for each fish to study them in relation to the condition of the fish. Fish in the maturity stages III to VI were considered as mature in this study. However, the bulk of the mature fish was in stage III and IV. The monthly average volume of the gut contents was considered as a reasonable criterion to denote the intensity of feeding.

LENGTH-WEIGHT RELATIONSHIP

The logarithmic regression equations obtained are as follows (Fig. 1):

Males: $\text{Log } W = -3.9468 + 3.4169 \text{ Log } L$

Females: $\text{Log } W = -3.9552 + 3.4367 \text{ Log } L$

The corresponding parabolic equations may be represented as

Males: $W = 0.0001131\ L^{3.4169}$

Females: $W = 0.0001109\ L^{3.4367}$

TABLE 1. *Comparison of the regression lines of the length-weight relationship of* Trichiurus lepturus.

	d.f	*b*	Deviations from regression *d.f.*	S. S.	M.S.
Within					
Males	184	3.4169	183	0.6555	0.003582
Females	142	3.4367	141	0.6788	0.004814
Pooled (Within)			324	1.3343	0.004118
Common	326	3.4258	325	1.3346	0.004106
Slope			1	0.0003	0.000300
Comparison of slopes: $F=13.73$ ($d.f=324, 1$) $F_{5\%}=254.3$					

The data were further analysed by the analysis of covariance (Snedecor, 1961) to test whether the slopes of the two regression equations differ significantly. It is evident from Table 1 that there was no significant difference in the slopes.

The correlation coefficient for the regression in the case of males was found to be 0.984 ($d.f.$ = 183, $r_{5\%}$ = 0.145 and $r_{1\%}$ = 0.190). In females the correlation coefficient was found to be 0.980 ($d.f.$ = 141, $r_{5\%}$ = 0.164 and $r_{1\%}$ = 0.215). In both the sexes r is significant.

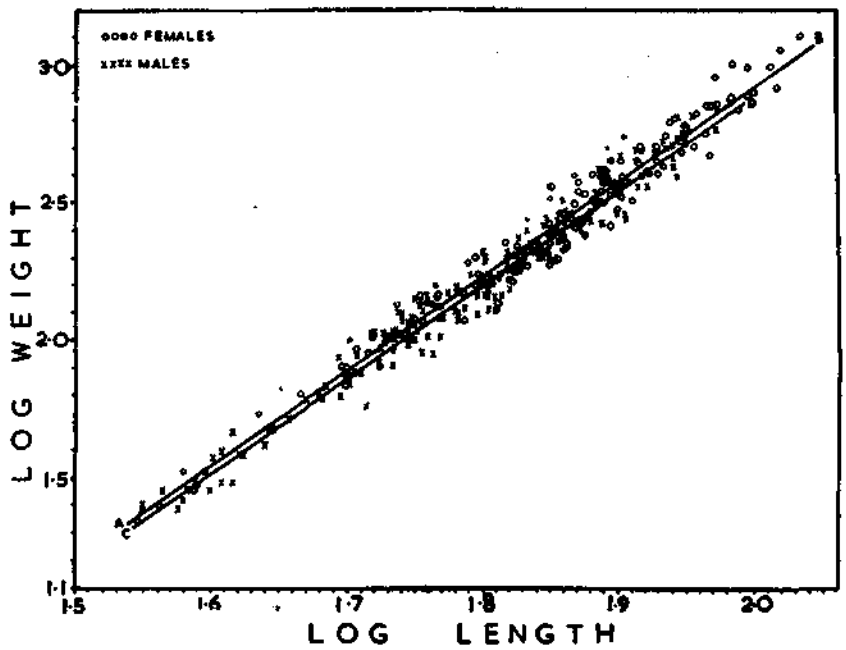

FIG. 1. Logarithmic relationship between length and weight in *Trichiurus lepturus*. AB and CD represent the regression lines of males and females respectively.

In order to see whether the regression coefficient differs from 3, the t test was applied. In males t was found to be 9.08 ($d.f.$ = 183, $t_{1\%}$ = 2.58; $t_{5\%}$ = 1.96) and in females 7.46 ($d.f.$ = 141, $t_{1\%}$ = 2.58; $t_{5\%}$ = 1.96). In both the sexes the regression coefficient is significantly different from 3 suggesting a deviation from the so called cube law and it shows that the fish grows at a higher rate than the cube of the length. However, the t test does not by itself prove that the growth is not isometric because whole fish were used in this study and maturing and mature fish formed a considerable proportion of the material examined.

CONDITION OF THE FISH

In males the K_n values are high from October to January and low in March-April (Fig. 2A). During the rest of the period the K_n values are more or less steady. The fish are mostly mature from January to July and immature in August-December period. The mean volume of food fluctuates from 0.7 to 7.2 ml from December to

September. However, in October and November the feeding intensity is high (20.7 and 10.6 ml respectively) and incidentally the higher K_n values are recorded in these months. The relative condition factor shows positive correlation with feeding intensity from August to December.

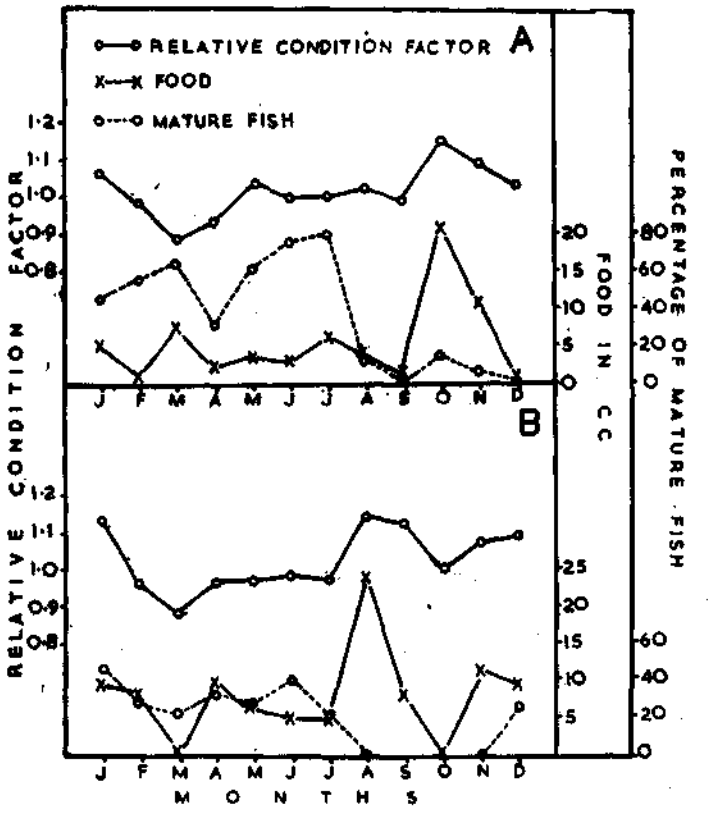

FIG. 2. Monthly fluctuations in the relative condition factor in *Trichiurus lepturus*. A males; B females.

In females the relative condition factor is high in August-September and again in November-January period, thus differing slightly from the condition obtained in males (Fig. 2B). The minor fluctuation observed can be due to sampling deficiency. The fish are mostly mature from December to July and immature in August-November period. The average volume of food during different months is less than 11.4 ml except in August when 23.5 ml was recorded and it is interesting to note that the highest K_n vlaue was obtained in the same month. The relative condition factor shows a positive correlation with feeding intensity during June - November and January - April periods.

The above data in both the sexes show no apparent correlation of the K_n values to the sexual cycle of the fish. However, the relative condition factor shows positive correlation with the volume of the food for some months, particularly so when the feeding intensity was very high.

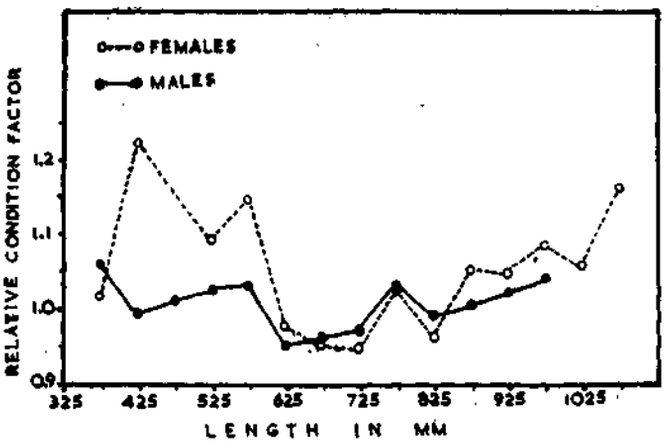

FIG. 3. Means of the values of the relative condition factor at different length in males and females in *Trichiurus lepturus*.

In Fig. 3 are plotted the mean K_n values of males and females separately at 5 cm length groups. In male the K_n values are very high up to 575 mm length and there is a sudden fall at 625 mm length, followed by increase in the K_n up to 975 mm length. In females the high K_n values abruptly fall at 625 mm length and a slight decline continued up to 725 mm length. Afterwards the K_n values increase up to 1075 mm length with slight fluctuation. The abrupt fall in the values of K_n at 625 mm length in both males and females is significant.

DISCUSSION

Misu (1964) studied the relationship between body length (measured from snout to anus) and weight in *T. lepturus* from the East China Sea population and the Yellow Sea Po-hai Bay population. He found that there are significant differences within sex between the two populations while the differences between the sexes within the same population are not significant.

Fluctuations in the condition of the fish during the different months have been attributed to a variety of reasons (Qasim, 1957; Sarojini, 1957; Gupta, 1967, 1968). In the present study on *T. lepturus*, except for January, in general, it was found that the high K_n values were obtained when the fish were not mature and low K_n values when the fish were mostly mature. Apparently the sexual cycle does not seem to influence the K_n values to any perceptible degree. On the other hand, the peak

values in the relative condition factor were obtained only in those months when the feeding intensity was very high. In a carnivorous fish like *T. lepturus*, which was found to devour big prey such as squids, octopus, mackerel, *Sphyraena* spp, *Saurida* spp, *Pellona* spp, etc., the weight of the prey could reasonably be expected to add to the body weight of the fish and thereby increase the K_n values. Sekharan's work (1955) on the variations of the muscle fats in *T. haumela* (=*T. lepturus*) gives some information on the condition of the fish. In both immature and mature fish (sexes not separated) he found that the muscle fats are high (4.4 to 6.0 average fat degrees) in September-January period while in February-August period the muscle fats are low (1.8 to 3.5 average fat degrees). He further observed that the fish are fattest in October-December and leanest in April. In the present study, if the sexes are considered conjointly, the K_n values are high from August to January and low during the rest of the period, the lowest being observed in March-April. Except for the month of August, there is a remarkable coincidence in the high and low values of K_n to the high and low values of muscle fats respectively.

Hart (1946) observed that "The point of inflexion on a curve showing the diminution of 'K' with increasing length is thus a good approximate indication of the length at which sexual maturity is attained." In the present study, a steep fall in the K_n values was observed at 625 mm length (Fig. 3). The unpublished observations of the present author. indicate that 91.11% of the fishes in the 625 mm length group were mature.

The abrupt fall in the K_n value at 625 mm length thus appears to be related to a stage when 90% of the fish are mature.

ACKNOWLEDGEMENTS

The author is thankful to Dr. R.V. Nair, Deputy Director for encouragement and to Dr. G. Seshappa and Dr. K.V. Sekharan for going through the manuscript and suggesting improvements.

REFERENCES

DAWSON, C.E. 1967. Contributions to the biology of the cutlass fish (*Trichiurus lepturus*) in the northern Gulf of Mexico. *Trans. Amer. Fish. Soc.*, **26**: 117-121.

GUPTA, M.V. 1967. Studies on the taxonomy, biology and fishery of ribbon fishes (Trichiuridae) of the Hooghly estuarine system. 2. Biology of *Trichiurus savala* Cuvier. *Proc. zool. Soc., Calcutta*, **20**: 153-170.

GUPTA, M.V. 1968. Studies on the taxonomy, biology and fishery of ribbon fishes (Trichiuridae) of the Hooghly estuarine system. 3. Biology of *Trichiurus pantului* Gupta. *Proc. zool. Soc., Calcutta*, **21**: 35-50.

*HART, T.J. 1946. Report on the trawling surveys on the Patagonian continental shelf. *Discovery Rep.*, **223**: 223-408.

LE CREN, E.D. 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatalis*). *J. Anim. Ecol.*, **20**: 201-219.

MISU, H. 1964. Fisheries biology on the ribbonfish (*Trichiurus lepturus*) in the East China and Yellow Seas. Bull. *Seikai Reg. Fish. Res. Lab.*, 32: 1-58.

PRABHU, M.S. 1955. Some aspects of the biology of the ribbonfish *Trichiurus haumela* (Forskal). *Indian J. Fish.*, 2 (1): 132-163.

QASIM, S.Z. 1957. The biology of *Blennius pholis* L (Teleostei). *Proc. zool. Soc. London*, 128 (2): 161-208.

SAROJINI, K.K. 1957. Biology and fisheries of the grey mullets of Bengal. I. Biology of *Mugil parsia* (Hamilton) with notes on its fishery in Bengal. *Indian J. Fish.*, 4 (1): 160-207.

SEKHARAN, K.V. 1955. Variations in the fat content of the muscle of the ribbon fish, *Trichiurus haumela* (Forskal). *J. Madras Univ.*, B. 25 (3): 301-322.

SNEDECOR, G.W. 1961. *Statistical Methods*. The Iowa College Press, Iowa.

* Not referred to the original.